REMARKS

This paper is responsive to the Final Office Action issued December 9, 2009. Reconsideration and allowance of **claims 1-7, 9-10, 12, 14-15, and 17-24** are requested.

The Office Action

Claims 1-3, 12, 14, 15, and 17 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Krause et al. (US 6,701,174) in view of Schweikard et al. (WO 02/09611) in further view of McInerney et al. (Deformable Models in Medical Image Analysis; Medical Image Analysis, 1.2 (1996) 91-108), in further view of Newell et al. (US 6,911,980) and in further view of Gauthier (US 2004/0012641).

Claims 4-10, 18, and 19 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Krause et al. in view of Schweikard et al. in further view of McInerney et al., in further view of Newell et al. in further view of Gauthier and in further view of Ohba (US 4,885,702).

Claims 20 and 21 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Krause et al. in view of Chaney et al. (US 5,926,568).

Claims 22 and 23 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Krause et al. in view of Chaney et al. in view of Schweikard et al. in further view of McInerney et al., in further view of Newell et al. in further view of Gauthier and in further view of Ohba.

The References of Record

Krause et al. discloses a computer assisted orthopedic surgery planner software for generation of 3D solid bone models from two or more 2D projection X-ray images of a patient's bone. For example, two orthogonal 2D X-ray projection images or shadowgrams of the target bone. The pair of shadowgrams is insufficient to reconstruct a 3D depiction of the target bone. Instead, Krause approximates a 3D image by fitting a 3D bone model to the two projection images or shadowgrams. The software starts with a 3D template bone model and deforms the 3D template bone model to substantially match the periphery of the patient's bone in the two shadowgrams. Because there is no data regarding the shape of the bone in other directions, this technique generates an approximation of the 3D surface but with significant potential errors.

A surgical planner and simulator module of the computer assisted orthopedic surgery planner software generates a simulated surgery plan showing the animation of a bone distraction process, the type and the size of the fixator frame to be mounted on the patient's bone, the frame mounting plan, the osteotomy/coricotomy site location and the day-by-day length adjustment schedule for each fixator strut. The exact 3D surface shape of the bone is not needed for this process.

Schweikar et al. functions much like Krause except that more shadowgrams are generated from different perspectives (angles). This improves the accuracy with which the model approximates the actual bone. But it is still an approximation model and not an accurate reconstruction (column 6, line 62).

McInerney et al. discloses background information about deformable models. The basic formulation of deformable models and their application to fundamental medical image analysis problems including segmentation, shape representative, matching and motion tracking are reviewed.

Newell et al. is directed to the graphic arts, not medical image reconstruction. Newell dicloses a shape manipulation method, relocation information is received indicative of an intended change in position of a target location on a curve or surface shape, the contour of the curve or surface shape being governed by control points. In response to the relocation information, new positions are determined for canonical locations on the shape based on predefined intended behaviors of the canonical locations.

Gauthier et al. is also directed to a graphic arts system. Gauthier generates a "representation" of a three dimensional entity using perspective to give the illusion of depth. No 3D reconstruction is performed. One cannot view the other side of the depicted entities. The entities are 2D, but due to shading and perspective, appear to represent a 3D space.

Ohba is also directed to the graphic arts, particularly computer graphics. Ohba discloses a method and apparatus for interactively generating and visually displaying deformed, free curved surfaces using a computer aided display apparatus by designating a desired deformation area, including an action point, on a non-deformed surface, determining a vector field function at each point within the deformation area; designating a deformation vector at the action point; adding the position vector P to the position vector to generate a position vector; and visually displaying the deformed curved surface represented by the position vector.

Chaney et al. is directed to the image recognition arts. Cheney dicloses a method, system, and computer program for automatic image recognition of standard shapes which include a core-based deformable skeletal grid used to define and represent an object via a model template. The template includes deformable segments, the changes of which are measurable against the deformed model corresponding to an object in a subsequent image. Statistical correlation techniques optimize the match to further refine the shape of the subsequent image.

Response to Response to Arguments

The Office Action asserts Krause et al. teaches using manual shape altering tools to modify and fit the shaped model to conform to the image data as required by **claim 20**. The Office Action refers Applicant to Col. 12 lines 42-46 and Col. 12 line 66 to Col. 13 line 16 of Krause which incorporates by reference Barr and Coquillart. More specifically, Barr discloses using a set of hierarchical transformations including stretching, bending, twisting, and tapering to deform an object. Coquillart discloses changing the shape of an existing surface either by bending the sure along an arbitrarily shaped curve or by adding randomly shaped bumps to the surface using non-parallelpiped type 3D lattices. Krause discloses applying the hierarchical and recursive refinement techniques to adjust deformation resolution through a sequential quadratic programming algorithm. Krause does not teach using those techniques so that a user can manually shape the shaped model to confirm to the image data.

Furthermore, in the new ground of rejection applied to claims 1, 2, 3, 14, 15 and 17 it is stated that Krause et al. does not specifically teach that the user interface is one by which a user manipulates the set of manual tools to modify selected regions of the selected 3D shape model to mach corresponding regions of the 3D image representation of the organ. It is respectfully submitted that neither Krause et al., nor Chaney et al., nor the combination thereof, teach or fairly suggest modifying and fitting a shape model to conform to image data using manual shape altering tools.

The Claims Distinguish Patentably
Over the References of Record

Claims 1-3, 12, 14, 15, and 17 are patentable over Krause et al. in view of Schweikard et al. in further view of McInerney et al. in further view of Newell et al. and in further view of Gauthier. Applicants respectfully submit that this rejection is improper and/or erroneous. Accordingly, the rejection is hereby traversed.

Krause and Schweikard are both drawn to a technique for approximating a 3D reconstruction where accuracy is not important. Krause has two shadowgrams that show the shadow or cross-sectional shape of the bone from two directions. Krause has a computer which stretches, scales, etc. a bone model until its shadow in the two directions substantially, within the limits of the fitting algorithm, matches the two shadows of the bone.

Implicit in Krause is an acceptance that the bone model is accurate for the current patient's bone. The patient's bone could have holes in it, or gouges, or flow which do not show up in the two shadows and which will not be depicted in the approximation of a 3D iamge that the fit model is taken as.

Schweikard is similar to Krause, but uses more than two shadows.

Neither Krause, nor Schweikard fit a 3D model to a 3D image. Rather, both try to "reconstruct" a 3D image by machine fitting a 3D model to 2D shadowgrams.

The other references are graphics arts programs that go more towards enablement than towards obviousness. They show how images can be manipulated with software routines, but do not put the reader in possession of using the disclosed techniques in fitting a 3D model to a 3D reconstructed image.

More specifically, regarding **claim 1**, Krause et al. does not disclose a reconstruction processor for reconstructing the image data into a three dimensional (3D) image representation of the organ and a set of global tools for best fitting the selected shape model to the 3D image representation of the organ or a set of manual tools for modifying selected regions of the selected shape model to precisely match the 3D image representation of the organ. The Office Action refers Applicant to Col. 11 lines 14-16, Col. 12 lines 4-7, 21-29, 42-46, and Col. 12 line 66 – Col. 13 line 15 which discloses an orthopedic surgery planner for scaling and deforming a predefined three-dimensional bone shape template until the bone shape template gives an image similar to the image data when projected onto a corresponding two

dimensional plane. Krause et al. does not disclose best fitting a selected model to the three-dimensional image representation of the image data and using manual tools for modifying regions of the model to precisely match the model to the three dimensional image representations of the plurality of the image data.

The Office Action asserts these limitations are taught in the combination of Schweikard et al., McInerney et al., Newell et al. and Gauthier. Schweikard et al. discloses generating a three-dimensional **approximation** model of an organ from 2-D images but does not teach or suggest global or manual tools to precisely fit a model to the two dimensional images. McInerney discloses 3D deformable surface models result in faster more robust segmentation techniques than applying 2D contour models slice by slice. Newell et al. discloses a shape manipulation method where relocation information is received indicative of an intended change in position of a target location on a curve or surface shape by one or more control points. Gauthier discloses a system and process to drop and drag three dimensional icons, e.g. a basketball into a scene on a display. Neither Krause et al., nor Schweikard et al., nor McInerney et al., nor Newell et al., nor Gauthier, nor the combination thereof, teach or fairly suggest generating a three-dimensional image representation of the image data and using manual tools for modifying regions of a model to precisely match the model to the three dimensional image representation.

To render a claim unpatentable the Office must do more than merely "consider" each and every feature for this claim. The asserted combination of Krause et al., Schweikard et al., McInerney et al., Newell et al. and Gauthier must also teach or suggest each and every claim feature **and the claimed combination of features**. It is respectfully submitted that there is no evidence or suggestions in Krause et al., Schweikard et al., McInerney et al., Newell et al., Gauthier, to combine them to create a reconstruction processor for reconstructing the image data into a three dimensional image representation of an organ and using global and manual tools for best fitting and matching a 3D model to the 3D image representation of the organ, as advanced by the Examiner, except from using Applicant's claims as a template through a hindsight reconstruction of the Applicant's claims.

Accordingly it is submitted that independent **claim 1** and **claims 2-7, 9-10, 12, and 14-15** that depend therefrom distinguish patentable over the references of record.

Claim 17 calls for reconstructing the image data into a three dimensional (3D) image representation of the object; dragging and dropping a selected 3D model on the 3D image representation of the object; and deforming local regions of the 3D model with a set of manual tools to match the 3D model to the 3D image representation of the object. It is respectfully submitted that neither Krause et al., nor Schweikard et al., nor McInerney et al., nor Newell et al., nor Gauthier, nor the combination thereof, teach or fairly suggest manually deforming regions of a three dimensional model to match a three dimensional image representation of an object.

Accordingly it is submitted that independent **claim 17** and **claims 18-19** that depend therefrom distinguish patentable over the references of record.

Claims 20 and 21 are patentable over Krause et al. in view of Chaney et al. Applicants respectfully submit that this rejection is improper and/or erroneous. Accordingly, the rejection is hereby traversed.

Claim 20 calls for applying manual shape-altering tools to the best-fit model such as to modify the model to conform to the image data. Krause et al. discloses a graphically user interface that allows a user to choose the bone contour from the 2D x-ray images of the bone and manipulate a three dimensional surgical plan simulation but does not disclose using the interface to effect fitting a model manually. Chaney et al. discloses using statistical correlation techniques to deform standard shape models in order to match the shape model to an object in an image, i.e., a computer implemented fitting. It is respectfully submitted that neither Krause et al., nor Chaney et al., nor the combination thereof, teach or fairly suggest modifying and fitting a shape model to conform to image data using manual shape altering tools.
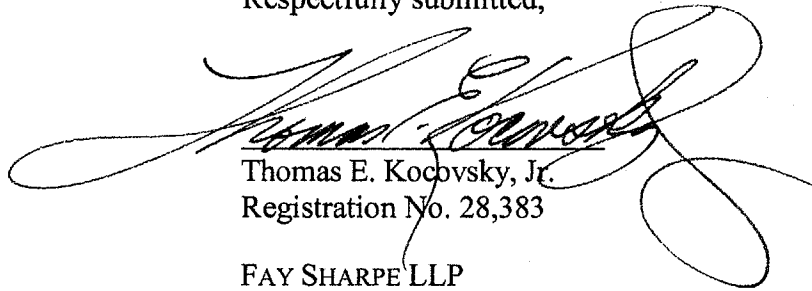
Accordingly it is submitted that independent **claim 20** and **claims 21-24** that depend therefrom distinguish patentable over the references of record.

CONCLUSION

For the reasons set forth above, it is submitted that **claims 1-7, 9-10, 12, 14-15, and 17-24** distinguish patentably over the references of record and meet all statutory requirements. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, the Examiner is requested to telephone Thomas Kocovsky at 216.363.9000.

Respectfully submitted,

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